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# OCEANUS

OCEANUS

EDITOR: JAN HAHN

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THE heaving line is in the air; in a few seconds R.V. 'Chain' will be tethered once again to the Institution dock, ending a cruise of three and a half months to the Equator and West Africa.

Perhaps the most significant achievements of the cruise were the mapping of a powerful eastbound counter current beneath the westbound surface current at the Equator, similar to the Cromwell current in the Pacific, and the location of a cut in the Mid-Atlantic Ridge (at 1° 15′ South and 13° 50′ West) through which bottom water formed in the Antarctic was flowing into the northeast Atlantic basin. Many other observations were made in several branches of ocean science, enough to keep the scientists on the beach for months as they work up data and grind out papers.

But not the 'Chain'. Within an hour after she was tied up the labs were being stripped of gear from the African cruise and new equipment was going aboard for the next one.

The fine cover photo is by Bob Allen.

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# Editorial

THE men who drilled the test Moholes in the Pacific this spring have pointed up one of the essential realities of science. With their drill bits reaching into the Earth's crust, their pipeline suspended in two miles of shifting water masses and their ship buffeted by wind and waves, they were constantly aware of the interdependence of the elements of earth, air and water of which the planet is made. At the same time the variety of investigators involved in the project — geologists, geophysicists, biochemists, bacteriologists, meteorologists and others — demonstrated the interdependence of the disciplines and the fundamental unity of science.

Despite the increasing and oft-belabored specialization and diversity of modern times — the so-called "knowing more and more about less and less" — ventures like the Mohole, the IGY and the space probes have served in recent years to make scientists and laymen alike aware that scientific endeavor is not fragmented; that every observation is part of the puzzle and must be considered in the light of others if it is to contribute to the quest for understanding.

Oceanographers have understood this for a long time, perhaps since the first seagoing biologist grudgingly helped his geologist shipmate to haul a bottom sample aboard — and found it teeming with interesting life. As you will read further on, Dr. Henry Bryant Bigelow recognized the overlapping of the disciplines when he brought together an assortment of specialists in the early days of the Institution. Countless occasions have demonstrated how the physical oceanographer leans on the chemist, the biologist on the marine meteorologist, the geologist on all the others and vice versa and back and forth. This constant crisscrossing of disciplines is one reason why oceanography down through the years has posed such a challenge — and proved so fascinating.

R.W.

**JAN HAHN,** the editor of OCEANUS, has been at sea this spring aboard the R.V. 'Chain' on her long cruise to the Romanche Trench. This issue was edited at Woods Hole during his absence.

# *Atmospheric Electricity and the Oceans*

By Duncan C. Blanchard

**"If it is really Jupiter and the other gods who rock the flashing frame of heaven with this appalling din and hurl their fire wherever they have a mind, why ——— do the throwers waste their strength on deserts? Are they getting their hand in and exercising their arms?"**

AND so spoke Lucretius, that great skeptic of two thousand years ago, whose curiosity and musings about atmospheric phenomena began to remove the vagaries of atmospheric electricity from the capricious behavior of the gods and to place them in the realm of cause-and-effect relationship. During the following centuries, however, the Lucretian brand of skepticism subsided and lay dormant. Little work of any significance was accomplished in atmospheric electricity until Benjamin Franklin, with his classic kite experiment, showed that the electricity of the atmosphere was the same as that which could be produced in the laboratory. From that time onward laboratory and field studies have been carried out by numerous investigators.

By the end of the last century it was known that the atmosphere, at least in regions of fair weather, carried a net positive charge. The individual charges were found to be carried by some of the air molecules, by smoke particles (both natural and man-made), and by various forms of airborne soil particles, among other things. The sum total of these charges, distributed mainly throughout the lowest 10,000 feet of the atmosphere, causes the electric potential to increase by about 50 volts for every foot in elevation above the surface of the earth. Thus, while one may not walk around with "his head in the clouds", he most definitely has his head in air that is normally at a potential of about 300 volts greater than that of the ground on which he walks. (The rate at which this potential changes with height defines what is commonly called the electric field).

WRIGHT

This atmospheric potential continues to increase with altitude, though somewhat more slowly, and attains the astonishingly high value of about 300,000 volts at an altitude of about 20,000 feet. If, at this point, you are wondering why you don't electrocute yourself the first time you walk out-of-doors, I hasten to add that the electrical current, as in most (but not all) problems involving electrostatics, is completely negligible in regard to harm to mankind. The current that flows from atmosphere to ground is far less than one million millionth of an ampere per square centimeter and is only about 1,400 amperes for the entire earth. Such currents nevertheless have great significance in certain geophysical problems.

Sometime after the discovery that the atmosphere was positively charged, it was realized that this charge was continually leaking off to the ground. The rate at which this occurred was such that the atmosphere should almost completely discharge itself within 30 minutes. But in the course of over 50 years of observations the atmospheric charge had shown no sufficient change. Investigators were thus forced to the conclusion that somehow, somewhere on the face of the earth (or, perhaps, in outer space) there existed a recharging mechanism, or "battery", by which the atmosphere was continually being recharged. What was the "battery" and how was it recharged? This was the tantalizing puzzle that faced workers in atmospheric electricity at the turn of the century.

One of the first hints of a solution came in 1924 when data obtained at sea by the research ship 'Carnegie' revealed that the strength of the surface electric field underwent a diurnal variation which reached a maximum at about six P.M. Greenwich time, regardless of position on the ocean. In other words, over the entire ocean area of the world the strength of the electric field waxed or waned simultaneously. Here was a strong clue that the recharging of the atmosphere was done in a manner that made itself known almost instantly anywhere on the face of the earth. A possible mechanism to explain this, based on an earlier suggestion by the English physicist, C. T. R. Wilson, was that the earth's thunderstorms were somehow pumping a positive electric current upward into the high reaches of the atmosphere where it could rapidly spread horizontally and subsequently return to the earth in the vast areas where fair weather occurs. If this idea were true, then one should find that the number of thunderstorms over the face of the globe should reach a maximum at about 6 Greenwich time. The meager data on thunderstorm activity were examined and, surprisingly enough, it was found that such a maximum appeared to exist. From this and other studies it was concluded that thunderstorms most likely constitute the main "battery" that continually recharges the atmosphere.

**Role of the Oceans**

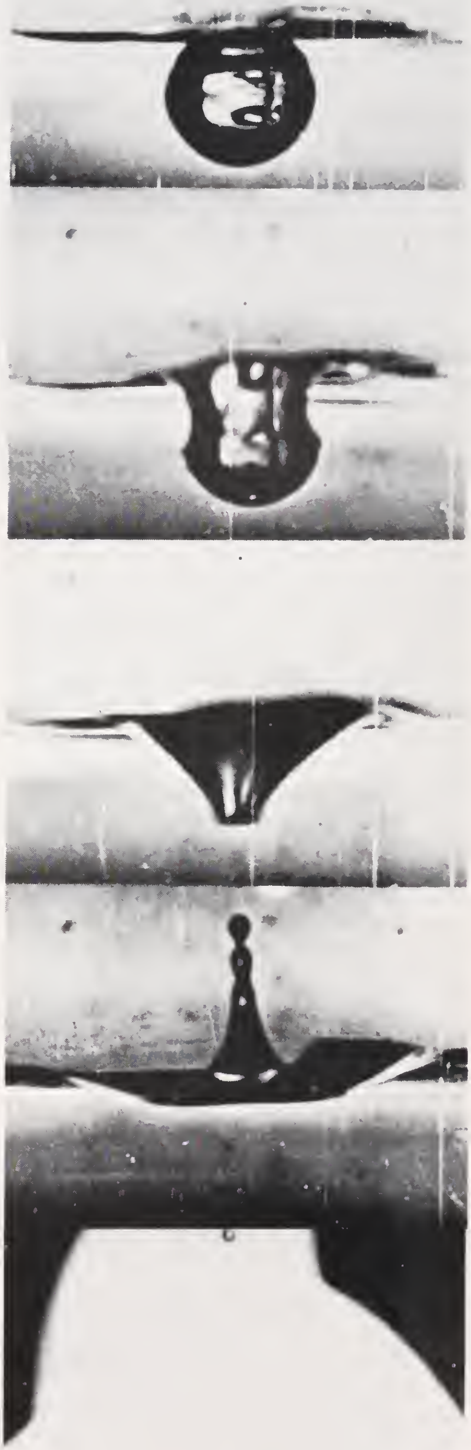
Where, then, do the oceans fit into the picture of the exchange of electricity between the atmosphere and the earth? We know, of course, that the vast expanse of the oceans, covering some 70 per cent of the surface of the earth, receives much of the electric current that flows down from the atmosphere. But our question is, "Do the oceans in some manner produce an electric current that flows up into the atmosphere to add to or deplete that which is presumed to originate in thunderstorms?" An answer to this question is not easy to come by. Measurements of the electric charge in the atmosphere over the oceans only lead to the further question, "How much of this charge, if any, really came from the oceans and how much came from thunderstorms or other sources?" It is hard to see how such measurements can ever answer this question so I suggest that we narrow our sights and look at that thin film of water that we call the surface of the sea, for it is here that any oceanic charge production must have its origin.

If you have ever watched the sea surface when the winds were light, you realize that it's a relatively tranquil place, disturbed only by small waves and by the undulations of the minute ripples from the cats-paws that move so swiftly across the surface. Though constantly changing in shape the water surface is not broken and no sea water spray can be ejected into the atmosphere. If any charges are rising from the sea under these conditions, they must be attached to the numerous water molecules that are continually moving from sea to atmosphere. While this hypothesis has been advanced by a number of people during the past 100 years, there are numerous other investigators who have failed to confirm it, either by experiment or theory. The prevailing opinion today is that any net charge flow from a

**DR. BLANCHARD**, a research associate in meteorology on our staff, came here in 1951 after working in atmospheric physics at General Electric with the late Dr. Irving Langmuir. In 1956 he was awarded an Associates' Fellowship and went to M.I.T., where he received his Ph. D. degree last January for the work described in this article.

water surface must be carried by small drops of water that are somehow torn or ejected fom this surface. And so we are led to look for some mechanism that can eject a great number of sea water drops from the sea surface.

This mechanism can be found in the bubbles that form in prodigious numbers whenever a wave breaks at sea. The air bubbles rise to the sea surface, break and eject minute drops of sea water at high speeds to heights up to 18 centimeters above the sea. Air turbulence may then carry many of these drops upward several hundreds of feet. The discovery that these drops carry an electric charge was purely accidental. One day, while we were observing the smoke-like haze of droplets that always forms in the air just over a sea water surface where myriads of bubbles are breaking, one of us happened to pull his comb from his pocket and charged it up by passing it once or twice through his hair. When the charged comb was held near the bubbling area the droplets from the breaking bubbles, instead of forming a haze, literally leaped from the sea water and streaked upward some 20 to 30 centimeters to the charged comb. Surely here was evidence that pointed to tremendous charging on drops coming from the sea. Or so we thought. After the initial excitement had died away, we began to analyze the basic physics of the situation and soon came to the conclusion that the only reason the drops were charged was that the pencil-like jet from the collapsing bubble had risen up into the electrical field of the charged comb. This charged the top of the jet by the classical electrostatic induction process, and therefore the drops that formed from the jet were also charged. But we still wondered if by any chance there would be some charge remaining on the drops if all electric fields near the breaking bubble were eliminated. A few simple experiments convinced us that this was most certainly true. We had apparently found in the breaking bubble a mechanism whereby the

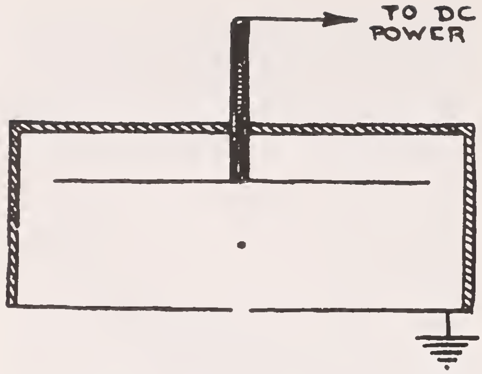


BLANCHARD

**Top photos show various stages in the collapse of a bubble and the formation of a jet, a sequence which occurs in about two thousandths of a second. The bottom picture is an oblique view of a jet.**

numerous ions in sea water were somehow being selectively "picked out" and put onto a drop that was then ejected into the overlying atmosphere. If the sign of the charge on the drop were always the same then we faced the exciting prospect that bubbles in the oceans of the world were continually pumping electric charges, or current, into the atmosphere.

I was, of course, quite anxious to pursue this problem and so began to devise methods to measure the charge on the drops. A number of techniques were tried; the one found most satisfactory was a modification of the simple but elegant method that Millikan first used in his classic oil drop experiment to determine the charge of the electron. My "Millikan-chamber" consisted essentially of two parallel metal plates, mounted horizontally about a centimeter apart. The bottom plate, which had a hole about 1.5 mm diameter at the center, was electrically grounded; the upper plate was connected to the output of a high voltage D.C. power supply. The plates were positioned above a sea water surface so that the drops from the jets of bursting bubbles were ejected upward through the hole in the lower plate and into an electric field between the plates. By adjusting the voltage on the upper plate, the upward force on the charged drop could be made equal to the gravitational force so the drop would remain freely suspended midway between the plates. With this experiment, I determined the electric charge on hundreds of drops of many different sizes from both large and small bubbles.

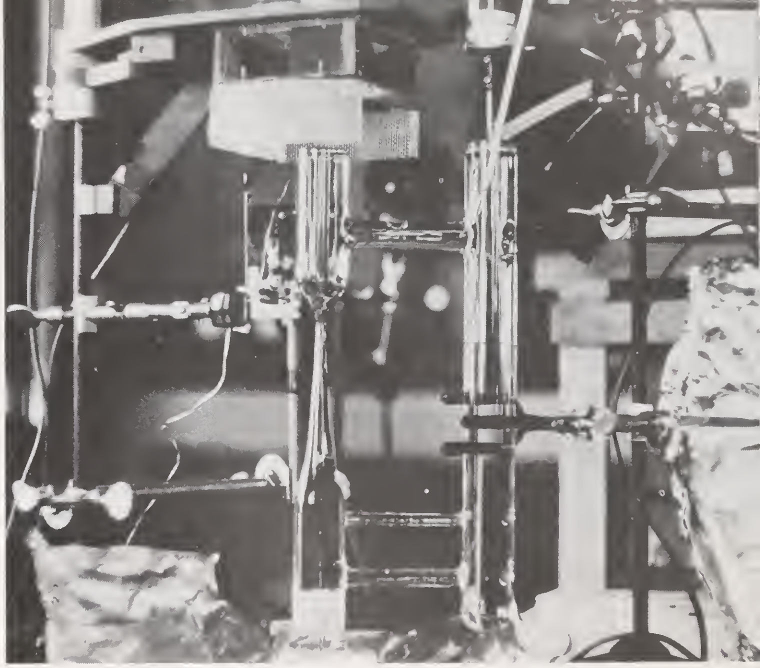



### Found Positive Charge

Many worthwhile findings came out of these experiments, the most interesting of which was the fact that the charge on the drops was always positive and had a magnitude that increased with age of the bubble. The average charge was about 2,000 times that carried by the electron. From this it seemed reasonable to conclude that whenever bubbles are formed in the sea by whitecaps they will break at the sea surface and eject positively-charged drops into the atmosphere. Many of these charged drops, being smaller than the average cloud drop, will be carried by winds high into the atmosphere. The total of all the charges on all the drops that are being carried upward from the entire world ocean each second constitutes an electric current. Calculations that I have made indicate that this positive current has a minimum value of 100 amperes, most of which is produced by the oceans of the southern hemisphere. This latter is hardly surprising when one considers the vast expanse of ocean in the southern hemisphere. The ocean-produced current is about 10 per cent of the total current that has been found over the oceans. Thus, it appears that the oceans are a modest but far from negligible rival to thunderstorms in the production of the positive electricity found in the atmosphere over the oceans.

But we have been speaking of the average or mean current production by the world ocean. What might happen when, for example, a thunderstorm occurs at sea? Remember our experiment with the comb. Why

Sketch at left shows the Millikan chamber in position over the source of bubbles. The dot in the chamber represents a charged drop from a bursting bubble. At right, apparatus is ready for action. The tubing is for circulating water downward to control the rate at which the bubbles rise to the surface.



BLANCHARD

wouldn't the strong electric field of the thunderstorm act in the same way as the field of the comb and induce high charges on the drops? The force of the electric field on the drops might cause them to rise from the sea and proceed upward toward the storm. From some experiments and calculations that I have made I see no reason as to why this should not occur, at least in part. In future work it will be of interest to look for this upward stream of charged particles beneath thunderstorms at sea. The current produced should be many times greater than that normally produced per unit area of ocean.

Can these charged drops play any role in the formation of clouds and rain? Laboratory studies by many people, dating back at least 100 years, indicate that electric charges on drops can profoundly modify the manner in which these drops interact and collide with others. What isn't known very well is how many of these laboratory phenomena are also natural phenomena. In a trip later this year to study clouds and rain on the windward side of the big volcanic island of Hawaii we hope, among other things, to find out if the charged drops from the sea are playing any role in the formation of oceanic rain.

And last, but possibly most important of all, is the very interesting problem of how the drops get charged in the first place. For the mere splashing of sea water does not produce such highly charged drops, and all of the same polarity, as does the bubble process. There seems to be something special about the bubble-charging mechanism that cannot be explained by present hypotheses of static charge generation. I do not know the answer, but I have an idea that it may require a laminar shear flow within the rising bubble jet. If such a flow actually occurs it could cause a shearing of the electrical double layer that must surround the bubble.

The prediction of an electric current flowing from ocean to atmosphere is but one of the interesting findings that have been uncovered in our investigations of the transfer of matter between the ocean and the atmosphere. The thin film of ocean through which all air-ocean transfer processes must occur is indeed a curious and complicated place. It has properties which differ from those of both the rest of the ocean and the atmosphere. Consequently, it is not surprising that we are so relatively ignorant of the chemistry and physics of the transfer of particulate matter from sea to atmosphere.


WRIGHT

Captain Cousteau in Wilmington

# Associates Go Underwater

TWO of the world's foremost undersea explorers have spoken this spring at meetings of the Associates of the Woods Hole Oceanographic Institution. On April 18 Capt. Jacques-Yves Cousteau, director of the Oceanographic Museum in Monaco, addressed a meeting sponsored by the Associates of the Wilmington, Del. area at the Du Pont Country Club. On May 18 the Associates met at the American Museum of Natural History in New York to hear Jacques Piccard, pioneer of the bathyscaphe 'Trieste'.

Captain Cousteau showed films of his two-man "diving saucer" and its 60-foot inflatable mother ship 'Amphitrite'. He described the latter as a big step toward his goal of airborne oceanographic vessels which can be collapsed and stowed on cargo planes for speedy delivery anywhere in the world.

Another of Captain Cousteau's aims is to enable men to spend more and more time underwater, to go ever deeper and to make more observations first-hand than is now possible.

Cousteau (with pipe) and diving saucer during 'Calypso' visit to Woods Hole in 1959.


BRAY


Jacques Piccard and his biographer, Alida Malkus.

Captain Cousteau was introduced by Dr. Paul M. Fye, director of the Institution. Homer Ewing of Wilmington, one of our trustees, was chairman for the evening.

M. Piccard showed movies of an early stratospheric balloon ascent by his father, Auguste Piccard, and films of the construction of the 'Trieste' and some of its dives. Noting that he was frequently praised for courage in diving to great depths, he commented:

"Actually, we were always afraid — but it was before the dive while we were planning the ship. We worked for years with caution and care so that we don't need courage when we dive."

He described his plans for a mesoscaphe — a mid-depth vehicle. Its primary advantages over the bathyscaphe would be much greater independence of a mother ship, many more windows and a bigger scientific payload. Such vehicles are being developed in many countries and will soon be a real oceanographic necessity, he added.

He was introduced by Alida Malkus, who has recently completed a biography of the Piccards — "Admirals of the Abyss" — for the Encyclopedia Britannica Press, and who is, moreover, the mother of Willem and the mother-in-law of Joanne Malkus of the Institution staff. Noel B. McLean, president of the Associates, was chairman. Dr. Fye presented Mrs. Malkus.

Dr. Selman Waksman talks with Mr. and Mrs. J. Seward Johnson at the New York dinner

# Fellowships, 1961

Two Associates' Fellowships have been renewed, to Bruce Warren, who is studying physical oceanography at M.I.T., and to Norman S. Neidell, who is studying in the department of physics at the Imperial College of Science and Technology in England.

In addition, the Institution has awarded 23 summer fellowships for 1961. Nine of the fellows will participate in a course in geophysical fluid dynamics to be given at the Institution under the direction of Dr. George Veronis on a National Science Foundation grant. The nine are:

Ivar Dugstad, research associate and Ph.D. degree candidate at the Institute of Theoretical Meteorology, University of Oslo.

Lionel Walter MacMillan, Ph.D. degree candidate in the department of physics, Institute of Oceanography, University of British Columbia.

Dr. Derek W. Moore, lecturer in the department of mathematics, University of Bristol, England.

Martin T. Mork, research associate and candidate for master's degree at the Oceanographic Institute, University of Oslo.

S. Nagarajan, graduate student in the department of physics, N.Y.U.

Pearn Peter Niiler, first-year graduate student, Cambridge University.

Dennis H. Peregrine, studying fluid dynamics at Cambridge.

Steven I. Rosencrans, graduate student in mathematics at M.I.T.

Fred C. Shure, candidate for the Ph.D. degree in the department of physics, University of Michigan.

The other fellowship winners:

Mario R. Capecchi, a senior majoring in chemistry at Antioch College, will work with Dr. Max Blumer.

Robert John Collier, second-year graduate student in the department of biology at Harvard University, will work with Dr. John Ryther.

Walter Eckhart, first-year graduate student at the Medical Research Council Unit for Molecular Biology at Cavendish Laboratory, England.

John Eric Edinger, candidate for master's degree in sanitary engineering at Johns Hopkins University, will work with Dr. B. H. Ketchum.

Santanu Kumar Ghose, candidate for the Ph.D. degree in geology at Florida State University, will work with Dr. John Zeigler.

Philip Gossett, a junior majoring in physics at Amherst College, will work with Dr. Arnold Arons.

James R. Greaves, a first-year student in the department of physics at the University of Minnesota, will work with Mr. Andrew Bunker.

Kurt Hecht, candidate for the master's degree in the department of geology at Brown University, will work with Dr. John Graham.

Bertil Hille, a junior majoring in zoology at Yale University, will work with Dr. John Kanwisher.

Eric L. Mills, first-year graduate student in the department of zoology at Yale, will work with Dr. Howard Sanders.

Donald C. Rhoads, first-year graduate student in the department of geology at the University of Iowa, will work with Dr. Rudolf Scheltema.

Robert S. Rhodes, candidate for the Ph.D. degree in the department of physics at Stamford University, will work with Dr. Earl Hays.

Ira Rubinoff, candidate for the Ph.D. degree at the Biological Laboratories at Harvard, will work with Dr. Richard Backus.

Charles G. Wing, a senior majoring in physics at Bowdoin College, will work with Mr. William G. Metcalf.

Above: The Blake Building — the only Institution building without a water view.
Below: The new hangar was designed to fit the Helio-Courier.


WRIGHT

# GROWTH

THE face of the Institution is changing rapidly. In the past nine months we have seen, among other things, the completion of the Blake Building behind the Barn, a seaplane hangar on Dyer's Dock, a new flagpole in front of the main building and the beginnings of an addition to the machine shop in back of the Laboratory of Oceanography.

The aerial view on the next two pages shows some of these new features and also two pieces of property acquired this year by the Institution: the former Daley Drug Store on the north side of Main Street across Eel Pond channel and the former Lowey's Spa at the corner of Main Street and Luscombe Avenue. (extreme right of picture).


GULF

WOODCOCK

**Melt patterns (and some footprints) can be seen in the snow on Flax Pond, Quisset. Ice in Buzzards Bay shows at top of picture.**

# A February Storm -- and Limnology

BY ALFRED H. WOODCOCK

HAVE you ever wondered about how the frozen surfaces of lakes and ponds adjust to the weight of newly fallen snow? Place an ice cube in water, add weight to the top and you will note that the ice sinks by an amount proportionate to the weight added. A continuous shore-to-shore ice sheet on a lake is not free to sink in this way, however, when a heavy blanket of snow falls on it. What actually happens?

A fortunate sequence of 1961 winter weather on Cape Cod offered a fine chance to answer this question. Sustained cold in January had formed a thick layer of ice over Flax Pond in Quisset. On Friday, Feb. 3, the water level in reference to the ice was measured by drilling a hole. The height to which the water rose was about right for the nine-inch thick ice.

Heavy snow fell on Saturday, covering the pond with almost a foot of undrifted snow. A visit to the pond on Sunday revealed that the original ice cover underlying the heavy snow was apparently unchanged. A new hole drilled in the ice produced a dramatic difference, however, for when the augur bit was withdrawn the pond water spurted up in a little fountain and began to diffuse outward through the surrounding snow. A glass tube placed vertically over the hole showed that the under-ice pressure was enough to force water up inside the tube almost three inches above the Friday level.

**MR. WOODCOCK** is perhaps the only Cape Codder who considered last winter's deep-freeze fortunate. He is an oceanographer on our staff and one of the few 30-year men at the Institution.

WOODCOCK

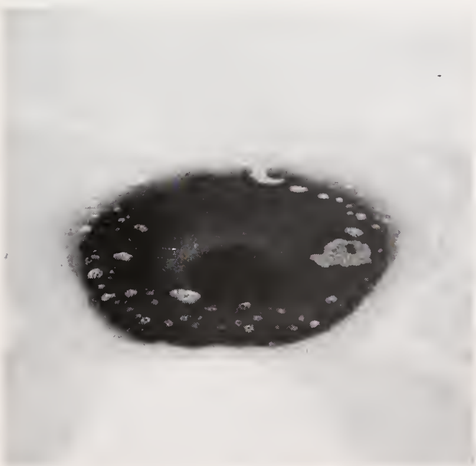
Tools of the trade.

This and other holes were tightly plugged with corks in the hope of making later measurements. However, the under-ice pressures produced leaks around the corks and at natural openings, so that on Monday water was welling up in several large round holes, reducing the lower part of the surrounding snow cover to slush and forming the curious radial melt patterns shown in the photographs. (We were able to get the aerial photo thanks to Bill Gallagher. whose plane had skis, and to Ted Spencer, research associate in meteorology, who helped shovel the drifts away from the hangar door.)

Several days were required to establish a pressure equilibrium under the ice. Even after the holes froze over at the top, water continued to flow out between the old and new ice, diffusing laterally through the snow. The flow was readily visible because of plankton and other matter suspended in the upwelling water.

These melt centers and patterns have sometimes been mistakenly thought to mark places where there were "springs" in the lake, or where convection cells under the ice had produced melting. It will take more study — and more cold Cape winters — to determine the reason for the odd radial patterns formed by the lateral spread of the upwelling water.

WOODCOCK



WOODCOCK

WRIGHT

# A Medal for Dr. Bigelow

DR. HENRY BRYANT BIGELOW received the oceanographic medal named in his honor at a quiet luncheon ceremony at the Harvard Faculty Club on March 16. About 35 guests were present, including members of Dr. Bigelow's family and some of his associates from the early days of the Institution and from the Museum of Comparative Zoology.

The medal was established by the board of trustees of the Institution last year, to be accompanied by a cash prize of $2,500. It was announced on Bigelow Day — August 10, 1960 — but the medal was not presented then because the trustees wanted the artist to have a chance to see the Bigelow profile in the flesh before recapturing it in clay, and that couldn't be done ahead of time without spoiling the surprise.

At the March luncheon Dr. Fye made up for the delay by presenting two medals — the gold one which really counts and a bronze replica for display. A second bronze copy is on view in the director's office at Woods Hole.

When the recipient of the medal got the floor he characteristically used the occasion to deliver a few salty opinions. It was all very nice, he commented, to give the first medal to Henry Bryant Bigelow, but the second winner should be selected with great care because that would determine the stature of the award. A really first-rate scientist should be picked, he said, to set a high standard by which the medal could be judged in the scientific community.

"We feel, sir," Dr. Fye responded, "that we have already set that standard with our first selection."

An affectionate appraisal of Dr. Bigelow's impact upon oceanography was given last August by Dr. Archibald G. Huntsman, former director of the Atlantic Biological Station in St. Andrews, N. B., and Dr. Alfred C. Redfield, senior oceanographer (emeritus) at the Institution. Excerpts from their talks are printed on the following pages.

Dr. Huntsman:

THE important thing about Dr. Bigelow is the effect he has had on different individuals, the way in which he has stimulated them. That effect has been enormous. I think perhaps it is well shown in a way in which many of you have experienced it — in his conduct of a meeting. Like all of us, he has his own peculiar personality, but his is more peculiar than that of anyone else I know, a queer combination of lively humor and deadly seriousness. His way with a meeting is inimitable . . . he has a sure grasp of the situation and he is very definite in striking right through to the pertinent points, and for that reason you have continued him in such a capacity, as chairman of the board of trustees, even after his retirement.

He had his vision of the ocean a long time ago. I would like to be able to tell you how that arose, if it could be told. I've known him for 45 years and he had it before that time. He was a biologist and his vision was naturally that of a biologist.

He saw a job that no one was doing. There were marine biologists in the MBL here who had been working for a long time; to him it seemed rather odd that none of them seemed to be studying the ocean. He felt that there should be some people who were prepared to go out and find out what is actually happening in the ocean and that, I think, is the clear part of his vision.

Suppose we try to come to grips with what the ocean is, and its life. The earth is a spherical solid enveloped by gas, with a thin intermediate layer, which is incomplete, of liquid. This liquid is the ocean, and plants and animals are able to live only in this layer or where water from this layer sufficiently penetrates the gas and the solids. The sea is in our blood — not figuratively, but literally, be-

COURTESY FISHERIES RESEARCH BOARD OF CANADA

**Drs. Huntsman (left) and Bigelow (right) at a meeting of the North American Council on Fishery Investigations at the Atlantic Biological Station in St. Andrews, N. B., in September 1933. Between them are Dr. J. Playfair McMurrich, chairman of the Biological Board of Canada and Dr. Harold Thompson, director of the Newfoundland Fishery Research Commission.**


Claude Ronne's well-known photograph of 'Atlantis' was used for the reverse side of the medal.

cause our blood has often been compared with the sea; we have our own internal sea.

Church, a biologist at Oxford University, claimed in fact that the sea is really alive. Why? Because one of our basic characteristics of life is the changes that take place — electrochemical changes in the transfer of ions from one molecule to another — and he said the salts in the sea are truly separated into ions for these very important chemical changes, so that in a very real sense the sea and life are connected.

Bigelow couldn't conceive of oceanography as something separate from the life in the ocean, from life itself. And who should investigate it? There is no reason why physicists shouldn't deal with animals and plants; these organisms have their own physics, but it's such complex physics that the physicists with their high ideals of accuracy throw up their hands. They can't do anything with it. You heard Dr. Iselin this morning telling how he himself as a physicist kept out in the middle of the ocean, keeping away from the coastal water because it got too complex.

That typifies it: If you have high ideals as a physicist you may be incapable of studying the complexities with which biologists perforce have to deal. And the ocean is outstandingly important for biology, so Bigelow, as a biologist, was the man to begin its study.

To me the really important aspect of Bigelow's influence on others is his own word 'exciting'. It is getting excited over odd facts that don't fit into your picture. Quite recently he was somewhat complaining because so many of the exciting facts obtained by fishery biologists were buried in mimeograph reports and nothing was being done about it.

It is things like that, keeping up the excitation, keeping up the feeling that there is something, as Kipling wrote it, something "lost beyond the ranges, lost and waiting for you — go. . ."

Dr. Bigelow has that spirit of discovery, of feeling there is something important to be found out and getting after it — and when he goes after it you know it isn't just a passing whim. He goes after it with vigor and does the thorough job that typifies him. Therefore, Dr. Bigelow as a biologist tried to bring in everything. In all our study of the ocean I know of no one else who so fully deserves recognition for what he has done for oceanography.


**Photos are about ⅞ actual size. The sculptor was Gilroy Roberts of Upper Darby, Pa.**

**Dr. Redfield:**

I can't remember very much about Dr. Bigelow prior to the founding of the Institution. We both lived in the same suburb of Boston and used to commute there together. My recollection of that period is that Henry would disappear, and then he would be on the train again, and I would say, "Henry, where have you been?"

He always said, "I've been to sea." I would say, "did you have a good trip?" "No," he would say, "I was seasick all the time." And I'm quite sure that he probably was seasick most of the time and it was his fortitude which bore him through while he produced his great works about the Gulf of Maine.

Now I've thought about time and I've discovered the obvious fact that it only goes in one direction — it is rather unique, I think, in not being reversible. But the human mind has a capability of going in both directions: We can look ahead with great uncertainty and we can look backward with great unreliability, because even if we find a written record we are quite sure that something is concealed.

It occurred to me then, looking back over the development of the Institution, that it is very much like looking through a telescope backwards — things get smaller and smaller with unusual rapidity. That is certainly true of our budgets and of personnel; it is not quite so true of scientific output. Then somehow you look into the right end of the telescope when you begin to think of the personalities — really very outstanding figures — who were here in those days. . . . .

Take, for example, the staff here in 1933. We had, of course, Dr. Bigelow as director. In physical oceanography we had Iselin and Seiwell, both in their late twenties. They were the only two full-time scientific employees, I think, that we had. I think that for the very obvious reason that there weren't physical oceanographers teaching around the country that could be gotten part time. In all events, those were the two that stayed here and kept the 'Atlantis' operating through the winter in Woods Hole.

Captain Soule was here, much as he is now through his connection with the Coast Guard. Sir Hubert Wilkins was a research associate but he never actually worked in the Institution. In marine bacteriology there was Waksman, with Charlie

Renn as his assistant; Miss Cornelia Carey was a research associate coming here from her job in New York.

In chemistry it was Norris Rakestraw and whatever students he might bring over from Brown during the summer time. In meteorology there was Dr. Rossby. Athelstan Spilhaus came very shortly after that time. In geology, Henry Stetson; in biology myself and George Clarke. Those were all the people that were listed as working in 1933.

Now I think it is a great tribute to you, Dr. Bigelow, that you were able to gather this group; that you knew enough to think of it and to persuade these people to come, because only a few had been to sea. You and Iselin and Seiwell were brought up on the ocean, in oceanography; Soule of course, also. Waksman, no; Renn, no; Carey, no; Rakestraw I think had worked one or two summers on some sea water problem. Dr. Rossby was then professor of meteorology at M.I.T., Henry Stetson was a geologist inclined toward the sea and I had worked on some problems in marine organisms. I was interested in the problems, not the marine organisms, except that here was an open field which I liked. I also liked to go sailing but I had never been to sea in a ship.

I think the genius was that you were able to see that you should have people like Rossby working in meteorology and Waksman in marine bacteriology. You saw a relation which they didn't see, and you brought them here.

WRIGHT

**THE BIGELOW MEDAL** was awarded for the first time with the following citation:

"The Henry Bryant Bigelow Medal, established by the trustees of the Woods Hole Oceanographic Institution in honor of Henry Bryant Bigelow, to be awarded to those making significant inquiries into the phenomena of the sea.

"Bestowed in the first instance upon Henry Bryant Bigelow in recognition of his monograph from his collections on the 'Albatross' expedition to the eastern tropical Pacific, his comprehensive investigations of the biology and physical oceanography of the New England waters and, especially, in gratitude for his leadership in the development of the marine sciences in the United States."

Out of this group of people there grew in ten years to be a nucleus with which we did our job during the war. Someone was asking how many people Dr. Bigelow had influenced. That I cannot answer with great precision but I have recently been concerned with a committee studying the problem of the education of oceanographers. We do it in two ways in this country. There have grown up and are increasing departments of oceanography, like these in California, Texas, and Washington. And then there are places like this that lure unwitting physicists, mathematicians, engineers and what not into the field and make oceanographers out of them. So far as I can judge about half the oceanographers now practicing in the United States — of which there are about 1,500 — have come in through our channel; I should say that a very large portion of those have come in through us. So I think it is fair to say five or six hundred oceanographers owe something to what is a rather unique educational system which Dr. Bigelow set up and which we, I hope, are still going to carry on.

There are two things which I remember as being noteworthy about life at this laboratory at that time. One was Dr. Bigelow's daily visits — with only a dozen laboratories to go to he was able to make the rounds almost daily, stimulating us in one way or another and always slyly say--ing, "Get to sea, get to sea!" To carry that out the 'Atlantis' was at the dock all summer, going out on one-week cruises. I had to take that boat for one week and darn well think up something worthwhile to do with it. It was the same with each of us, so that everybody in the Institution got a very close and equal look at the ocean. There are many people at the Institution today who have not had this very stimulating experience of going to sea, of seeing what it looks like and getting into close contact with this very great, strange and unknown thing. It was a privilege for us to have been brought up under that system, and I hope very much that we will be able to find ways of increasing that type of educational activity among our people.

**The president and the chairman of the board.**

WRIGHT

# Whale Ashore

INSTITUTION scientists went whaling in the city dump in Newport, Rhode Island, on March 15. Their quarry was the carcass of a rare beaked whale, **Ziphius cavirostris,** which they brought back to Woods Hole in a pickup truck.

The whale, an adult male about 19 feet long, came ashore on Easton's Beach, Newport, on Monday the 13th. Local police and firemen tried to tow it to sea with the aid of skin-divers and an amphibious vehicle, but the animal kept returning to the beach so they finally killed it and loaded it on a flatbed truck for disposal at the dump.

The Woods Hole whalers, who had flown down in the Helio-Courier when they got word of the stranding, appealed on Tuesday to Newport's city manager, George A. Bisson. Mr. Bisson, who had also heard from a Dartmouth College biologist, agreed to postpone the interment in the interests of science. While the whale was on the flatbed it was weighed on a truck scale — 5,580 pounds.

Richard H. Backus, William E. Schevill and Robert G. Weeks performed the dissection. The heart and lungs went to Dartmouth, the head went into the deep-freeze at Sam Cahoon's fish market on the steamship landing and the bones went over the side of the Institution dock in cages to be picked clean by the Woods Hole fish.

## With the Ships

FRANK J. MATHER III, who reported on his spectacular tuna catch of last fall in the March issue of OCEANUS, has gone off on another long-lining cruise in 'Crawford,' this time to Florida and Caribbean waters. On the way south he took time to make a set at Hydrographer Canyon, where he caught 185 bluefins last November. The April take: 14 sharks, eight lancetfish and — as expected — no tuna. 'Crawford' is due back at Woods Hole on June 8.

After a spell in the shipyard at the end of her long Mediterranean cruise, 'Atlantis' went on a round trip to Bermuda waters with Dr. Howard Sanders, who has received a grant from the National Science Foundation to extend his studies of bottom-dwelling animals from the shallows of Cape Cod to the ocean depths. Later this month she will leave with Thomas R. Stetson to continue our examination of the Blake Plateau structures.

'Chain' is setting a line of anchored instrumented buoys between Gay Head and Bermuda for Dr. William S. Richardson. In mid-June Dr. J. B. Hersey will take her south for a detailed examination of the north wall of the Puerto Rico Trench with microbathymetry, color stereo photography, coring, dredging and acoustical examination of the subsurface layers. In mid-August 'Chain' will leave for a five-month cruise to the eastern Mediterranean where scientists from several European nations will work with ours in hydrography and all aspects of submarine geophysics.

# Currents and Tides

'Aries' is no longer a research vessel. She was sold early this spring to the Man Johnson Co. Ltd. of Panama, one of the holdings of Mr. John Theodoracopulos, a Greek shipowner. Mr. Theodoracopulos has taken 'Aries' to Greece, where she will be used as a yacht.

The 93-foot ketch was built for Mr. R. J. Reynolds of Sapelo Island, Georgia, who turned her over to the Institution in 1959. During most of her service for Woods Hole 'Aries' was used out of Bermuda in a study of deep ocean currents under the direction of Dr. John C. Swallow of the National Institute of Oceanography in England. The work was described by Mrs. Swallow in the March issue of OCEANUS.

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Bids for construction of the Institution's new research vessel will be opened at Woods Hole on June 15. The ship is expected to be ready to go to sea and do scientific work by late spring of 1963.

The new vessel — still unnamed — will be the first wholly new addition to the Woods Hole fleet since 'Atlantis' was built in 1931. She will be 195 feet on the waterline, of welded steel construction and with twin-screw steam-powered propulsion. There will be accommodations for 25 scientists and a crew of 28.

The design agent has been Bethlehem Steel Company's Shipbuilding Division in Quincy, Mass. M. Rosenblatt & Son of New York City is the design associate. Jonathan Leiby, naval architect, and Richard S. Edwards, marine superintendent, have headed the Institution's design committee.

Construction and design are being paid for by a grant from the National Science Foundation.

Henry M. Stommel, physical oceanographer on our staff and professor of oceanography at Harvard University, has been elected to membership in the National Academy of Sciences.

Mr. Stommel is noted for his theoretical studies of the dynamic ciruclation of the oceans. He is the author of "The Gulf Stream," published in 1958, and is working on an atlas of the deep oceans.

He came to Woods Hole in 1944 from Yale University, where he had taught mathematics and astronomy after graduation. He was professor of oceanography at the Massachusetts Institute of Technology before he accepted his present post at Harvard last year.

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Dr. Benjamin H. Alton of Woods Hole, a member of the executive committee of the Associates since 1952, died at his home on April 19.

Harry Alfandre, New York, who had been a life member of the Associates since 1955, died on March 6.

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Noel B. McLean, president of the Associates of the Woods Hole Oceanographic Institution, and Mrs. McLean have recently joined the ranks of life members of the Associates.

Sportsmen who take part in the Institution's gamefish tagging program will be able from now on to signal their cooperation with a red-and-white flag, to be flown whenever a fish is tagged and released.

The flags will be distributed to participants along with the tags by Frank J. Mather III, research associate in oceanography, who is in charge of the tagging program. Another new development is the introduction of zippered plastic bags to keep the tags and data cards dry aboard ship.

The American Association for the Advancement of Science has published a volume containing the invited lectures presented at the International Oceanographic Congress held in New York in September, 1959.

Entitled simply "Oceanography," the book is listed as Publication No. 67 of the A.A.A.S. It contains 30 papers dealing with a variety of subjects under five general headings: History of the Oceans, Population of the Sea, The Deep Sea, Boundaries, and Cycles of Organic and Inorganic Substances in the Ocean.

The book was edited by Dr. Mary Sears of this Institution with the assistance of Miss Ruth C. Christman of the A.A.A.S. Dr. Sears, a planktonologist on our research staff and clerk of the Institution corporation, also served as chairman of the commitee on arrangements for the International Oceanographic Congress. Dr. Roger Revelle of the Scripps Institution of Oceanography wrote the introduction.

MUNNS

# Associates

## of the

# Woods Hole Oceanographic Institution

(A private, non-profit, research organization)

THE ASSOCIATES of the Woods Hole Oceanographic Institution are a group of individuals, corporations and other organizations who, because of their love for the sea and interest in science and education, support and encourage the research and related activities of the Institution.

Membership dues in the Associates are as follows:

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| Member | $50 |
| Contributing Member | $100 |
| Patron | $500 |
| Life Member | $1,000 |
| Corporate Member | $1,000 |
| Sustaining Corporate Member | $5,000 or more. |

All contributions and dues are tax deductible to the extent provided by law.

NOEL B. McLEAN, **President**
JOHN A. GIFFORD, **Secretary**
RONALD A. VEEDER, **Executive Assistant**

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